

## PERFORMANCE SPECIFICATION

SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED  
(TOTAL DOSE AND SINGLE EVENT EFFECTS) TRANSISTOR, N-CHANNEL  
SILICON TYPES 2N7515, 2N7516, AND 2N7517  
JANTXVD, R AND JANSJ, R

This specification is approved for use by all Departments  
and Agencies of the Department of Defense.

## 1. SCOPE

1.1 Scope. This specification covers the performance requirements for a N-Channel, enhancement-mode, MOSFET, radiation hardened (total dose and single event effects (SEE) characterization), power transistor. Two levels of product assurance are provided for each device type as specified in MIL-PRF-19500.

1.2 Physical dimensions. See figure 1, TO-205AF.

1.3 Maximum ratings.  $T_A = +25^\circ\text{C}$ , unless otherwise specified.

Type	$P_T$ $T_C = +25^\circ\text{C}$	$V_{DS}$	$V_{DG}$	$V_{GS}$	$I_{D1} (1)$ $T_C = +25^\circ\text{C}$	$I_{D2} (1)$ $T_C = +100^\circ\text{C}$	$I_S (1)$	$I_{DM}$	$T_J$ and $T_{STG}$	$V_{ISO}$ 70,000 ft. altitude
	<u>W</u>	<u>V dc</u>	<u>V dc</u>	<u>V dc</u>	<u>A dc</u>	<u>A dc</u>	<u>A dc</u>	<u>A (pk)</u>	<u>°C</u>	<u>V dc</u>
2N7515	25 (2)	100	100	$\pm 30$	12	8	12	48	-55	N/A
2N7516	25 (2)	200	200	$\pm 30$	8	5	8	29	to	N/A
2N7517	25 (2)	250	250	$\pm 30$	7	4	7	28	+150	250

(1)  $I_D = ((T_{Jmax} - T_C)/((R_{\theta JC})X(r_{DS(on)} \text{ at } T_{Jmax})))^{1/2}$ .

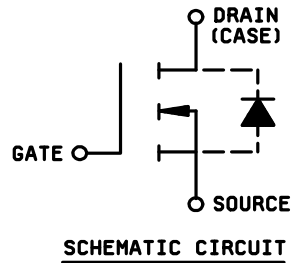
(2) Derate linearly  $0.20 \text{ W}/^\circ\text{C}$  for  $T_C > +25^\circ\text{C}$ ;  $P_T = (T_{Jmax} - T_C)/R_{\theta JC}$ .

1.4 Primary electrical characteristics at  $T_C = +25^\circ\text{C}$ .

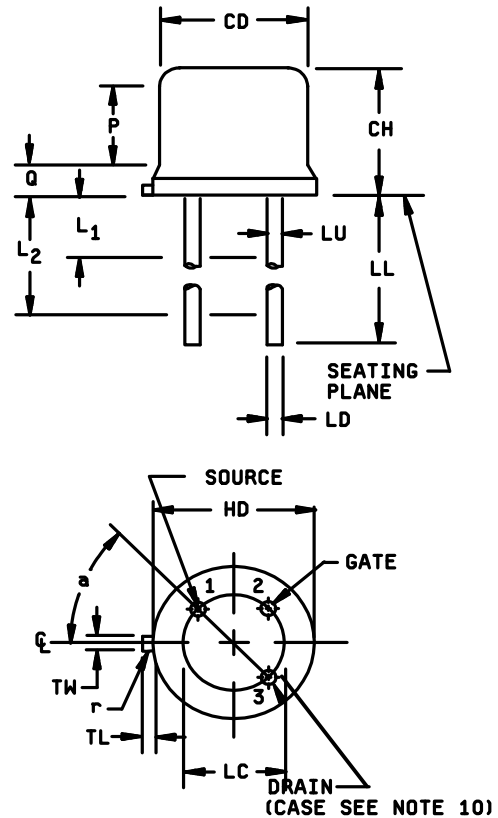
Type	Min $V_{(BR)DSS}$ $V_{GS} = 0$ $I_D = 1.0 \text{ mA dc}$	$V_{GS(TH)1}$ $V_{DS} = V_{GS}$ $I_D = 1.0 \text{ mA dc}$	Max $I_{DSS1}$ $V_{GS} = 0$ $V_{GS} = 80\%$ of rated $V_{DS}$	Max $r_{DS(on)} (1)$ $V_{GS} = 12\text{V}$		$R_{\theta JC}$ Max	$I_{AS}$
				$T_J = 25^\circ\text{C}$ at $I_{D2}$	$T_J = 125^\circ\text{C}$ at $I_{D2}$		
	<u>V dc</u>	<u>V dc</u> Min    Max 2.0    4.5	<u><math>\mu\text{A dc}</math></u>	<u><math>\Omega</math></u>	<u><math>\Omega</math></u>	<u><math>^\circ\text{C/W}</math></u>	<u>A (pk)</u>
2N7515	100		25	0.080	0.129	5.0	48
2N7516	200			0.180	0.324		29
2N7517	250			0.255	0.510		28

(1) Pulsed (see 4.5.1).

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Defense Supply Center, Columbus, ATTN: DSCC/VAC, Post Office Box 3990, Columbus, OH 43216-5000, by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.



Symbol	Dimensions				Notes
	Inches		Millimeters		
	Min	Max	Min	Max	
CD	.305	.355	7.75	9.02	
CH	.160	.180	4.07	4.57	
HD	.335	.370	8.51	9.40	
LC	.200 TP		5.08 TP		6
LD	.016	.021	.041	0.53	7, 8
LL	.500	.750	12.7	19.05	7, 8
LU	.016	.019	0.41	0.48	
L <sub>1</sub>		.050		1.27	7, 8
L <sub>2</sub>	.250		6.35		7, 8
P	.070		1.78		5
Q		.050		1.27	7
TL	.029	.045	0.74	1.14	3
TW	.028	.034	0.71	0.86	2
r		.010		0.25	9
α	45°TP		45°TP		6



## NOTES:

1. Dimensions are inches. Metric equivalents are given for general information only.
2. Beyond radius (r) maximum, TW shall be held for a minimum length of .011 inch (0.028 mm).
3. Dimension TL measured from maximum HD.
4. Outline in this zone is not controlled.
5. Dimension CD shall not vary more than .010 inch (0.25 mm) in zone P. This zone is controlled for automatic handling.
6. Leads at gauge plane .054 +.001, -.000 inch (1.37 +0.03, -0.00 mm) below seating plane shall be within .007 inch (0.18 mm) radius of true position (TP) at maximum material condition (MMC) relative to tab at MMC.
7. LU applies between L<sub>1</sub> and L<sub>2</sub>. LD applies between L<sub>2</sub> and LL minimum. Diameter is uncontrolled in L<sub>1</sub> and beyond LL min.
8. All three leads.
9. Radius (r) applies to both inside corners of tab.
10. Drain is electrically connected to the case.
11. In accordance with ANSI Y14.5M, diameters are equivalent to  $\phi$ x symbology.

FIGURE 1. Physical dimensions for TO-205AF.

## 2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements documents cited in sections 3 and 4 of this specification, whether or not they are listed.

### 2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation (see 6.2).

#### SPECIFICATION

##### DEPARTMENT OF DEFENSE

MIL-PRF-19500 - Semiconductor Devices, General Specification for.

#### STANDARD

##### DEPARTMENT OF DEFENSE

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Unless otherwise indicated, copies of the above specifications, standards, and handbooks are available from the Document Automation and Production Services (DAPS), Building 4D (DPM-DODSSP), 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

## 3. REQUIREMENTS

3.1 General. The requirements for acquiring the product described herein shall consist of this document and MIL-PRF-19500.

3.2 Qualification. Devices furnished under this specification shall be products that are manufactured by a manufacturer authorized by the qualifying activity for listing on the applicable qualified manufacturer's list (QML) before contract award (see 4.2 and 6.3).

3.3 Abbreviations, symbols, and definitions. Abbreviations, symbols, and definitions used herein shall be as specified in MIL-PRF-19500.

3.4 Interface and physical dimensions. The interface and physical dimensions shall be as specified in MIL-PRF-19500 and on figure 1 (TO-205AF) herein.

3.4.1 Lead finish. Unless otherwise specified, lead finish shall be solderable in accordance with MIL-PRF-19500, MIL-STD-750, and herein. Where a choice of lead finish is desired, it shall be specified in the acquisition document (see 6.2).

3.5 Electrostatic discharge protection. The devices covered by this specification require electrostatic discharge protection.

3.5.1 Handling. MOS devices must be handled with certain precautions to avoid damage due to the accumulation of static charge. However, the following handling practices are recommended (see 3.5).

- a. Devices should be handled on benches with conductive handling devices.
- b. Ground test equipment, tools, and personnel handling devices.
- c. Do not handle devices by the leads.
- d. Store devices in conductive foam or carriers.
- e. Avoid use of plastic, rubber, or silk in MOS areas.
- f. Maintain relative humidity above 50 percent if practical.
- g. Care should be exercised during test and troubleshooting to apply not more than maximum rated voltage to any lead.
- h. Gate must be terminated to source,  $R \leq 100 \text{ k}$ , whenever bias voltage is to be applied drain to source.

3.6 Electrical performance characteristics. Unless otherwise specified herein, the electrical performance characteristics are as specified in 1.3, 1.4, and table I herein.

3.7 Electrical test requirements. The electrical test requirements shall be the subgroups specified in table I herein.

3.8 Marking. Marking shall be in accordance with MIL-PRF-19500. At the option of the manufacturer, marking may be omitted from the body, but shall be retained on the initial container.

3.9 Workmanship. Semiconductor devices shall be processed in such a manner as to be uniform in quality and shall be free from other defects that will affect life, serviceability, or appearance.

#### 4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.2).
- b. Screening (see 4.3)
- c. Conformance inspection (see 4.4 and tables I and II).

4.2 Qualification inspection. Qualification inspection shall be in accordance with MIL-PRF-19500 and as specified herein.

4.2.1 Group E inspection. Group E inspection shall be conducted in accordance with MIL-PRF-19500 and table III herein. End-point electrical measurements shall be in accordance with the applicable tests of table I, group A, subgroup 2 herein.

4.2.1.1 SEE. Design capability shall be tested on the initial qualification and thereafter whenever a major die design or process change is introduced. See the design safe operation area figures herein. End-point measurements shall be in accordance with table IV.

4.3 Screening (JANS and JANTXV levels only). Screening shall be in accordance with table IV of MIL-PRF-19500, and as specified herein. The following measurements shall be made in accordance with table I herein. Devices that exceed the limits of table I herein shall not be acceptable.

Screen (see table IV of MIL-PRF-19500)	Measurement	
	JANS level	JANTXV level
(1)	Method 3470 of MIL-STD-750, $E_{AS}$ (see 4.5.4).	Method 3470 of MIL-STD-750, $E_{AS}$ (see 4.5.4).
(1)	Method 3161 of MIL-STD-750 (see 4.5.3).	Method 3161 of MIL-STD-750 (see 4.5.3).
(1)	Gate stress test (see 4.5.5).	Gate stress test (see 4.5.5).
(2)	Subgroup 2 of table I herein.	Subgroup 2 of table I herein.
9	$I_{GSS}$ , $I_{DSS1}$ as a minimum.	$I_{GSS}$ , $I_{DSS1}$ as a minimum.
10	Method 1042 of MIL-STD-750, test condition B.	Method 1042 of MIL-STD-750, test condition B.
11	$I_{GSSF1}$ , $I_{GSSR1}$ , $I_{DSS1}$ , $r_{DS(ON)}$ , $V_{GS(TH)}$ Subgroup 2 of table I herein; $\Delta I_{GSSF1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater.  $\Delta I_{GSSR1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater.  $\Delta I_{DSS1} = \pm 25$ $\mu$ A dc or $\pm 100$ percent of initial value, whichever is greater.	$I_{GSSF1}$ , $I_{GSSR1}$ , $I_{DSS1}$ , $r_{DS(ON)}$ , $V_{GS(TH)}$ Subgroup 2 of table I herein.
12	Method 1042 of MIL-STD-750, test condition A, 240 hours minimum.	Method 1042 of MIL-STD-750, test condition A, 160 hours minimum.
13	Subgroups 2 and 3 of table I herein; $\Delta I_{GSSF1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater.  $\Delta I_{GSSR1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater.  $\Delta I_{DSS1} = \pm 25$ $\mu$ A dc or $\pm 100$ percent of initial value, whichever is greater.  $\Delta r_{DS(ON)1} = \pm 20$ percent of initial value.  $\Delta V_{GS(TH)1} = \pm 20$ percent of initial value.	Subgroup 2 of table I herein; $\Delta I_{GSSF1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater.  $\Delta I_{GSSR1} = \pm 20$ nA dc or $\pm 100$ percent of initial value, whichever is greater.  $\Delta I_{DSS1} = \pm 25$ $\mu$ A dc or $\pm 100$ percent of initial value, whichever is greater.  $\Delta r_{DS(ON)1} = \pm 20$ percent of initial value.  $\Delta V_{GS(TH)1} = \pm 20$ percent of initial value.

- (1) Shall be performed anytime before screen 10.  
 (2) Shall be performed after  $E_{AS}$  test, method 3161, and gate stress test.

4.4 Conformance inspection. Conformance inspection shall be in accordance with MIL-PRF-19500, and as specified herein. Alternate flow is allowed for conformance inspection in accordance with figure 4 of MIL-PRF-19500.

4.4.1 Group A inspection. Group A inspection shall be conducted in accordance with table V of MIL-PRF-19500.

4.4.2 Group B inspection. Group B inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VIa (JANS) and table VIb (JANTXV) of MIL-PRF-19500, and herein. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein. Delta  $V_{SD}$  measurements shall be in accordance with table IV herein.

4.4.2.1 Group B inspection, table VIa (JANS) of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B3	1051	Test condition F or G, 100 cycles.
B4	1042	Intermittent operation life, condition D, 2,000 cycles. No heat sink or forced-air cooling on the device shall be permitted during the on cycle. $T_{on}$ = 30 seconds minimum.
B5	1042	Accelerated steady-state reverse bias, condition A.
B5	1042	Accelerated steady-state gate bias, condition B.
B5	2037	Bond strength (Al – Au die interconnects only), test condition A.
B6	3161	Thermal resistance, see 4.5.2.

4.4.2.2 Group B inspection, table VIb (JANTXV) of MIL-PRF-19500.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
B3	1042	Intermittent operation life, condition D, 2,000 cycles. No heat sink or forced-air cooling on the device shall be permitted during the on cycle. $T_{on}$ = 30 seconds minimum.
B5	3161	Thermal resistance, see 4.5.2.

4.4.3 Group C inspection. Group C inspection shall be conducted in accordance with the conditions specified for subgroup testing in table VII of MIL-PRF-19500 and as follows. Electrical measurements (end-points) shall be in accordance with table I, group A, subgroup 2 herein. Delta  $V_{SD}$  measurements shall be in accordance with table IV herein.

<u>Subgroup</u>	<u>Method</u>	<u>Condition</u>
C2	2036	Terminal strength, test condition E, weight = 8 ounces., 3 arcs.
C6	1042	Intermittent operation life, condition D, 6,000 cycles. No heat sink or forced-air cooling on the device shall be permitted during the on cycle. $T_{on}$ = 30 seconds minimum.

4.4.4 Group D inspection. Group D inspection shall be conducted in accordance with table VIII of MIL-PRF-19500 and table II herein.

TABLE I. Group A inspection.

Inspection <u>1</u> /	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 1</u>						
Visual and mechanical inspection	2071					
<u>Subgroup 2</u>						
Thermal impedance <u>2</u> /	3161	See 4.5.3 and figure 2	$Z_{\theta JC}$		1.05	°C/W
Breakdown voltage, drain to source 2N7515 2N7516 2N7517	3407	$V_{GS} = 0$ V dc, $I_D = 1$ mA dc, bias condition C	$V_{(BR)DSS}$	100 200 250		V dc V dc V dc
Gate to source voltage (threshold)	3403	$V_{DS} = V_{GS}$ , $I_D = 1$ mA dc	$V_{GS(TH)1}$	2.0	4.5	V dc
Gate current	3411	$V_{GS} = \pm 30$ V dc, bias condition C, $V_{DS} = 0$	$I_{GSS1}$		$\pm 100$	nA dc
Drain current	3413	$V_{GS} = 0$ V dc, bias condition C, $V_{DS} = 80$ percent of rated $V_{DS}$	$I_{DSS1}$		25	$\mu$ A dc
Static drain to source on-state resistance 2N7515 2N7516 2N7517	3421	$V_{GS} = 12$ V dc, condition A, pulsed (see 4.5.1), $I_D = I_{D2}$	$r_{DS(on)1}$		0.080 0.180 0.255	$\Omega$ $\Omega$ $\Omega$
Static drain to source on-state voltage 2N7515 2N7516 2N7517	3405	$V_{GS} = 12$ V dc, condition A, $I_D = I_{D1}$ , pulsed (see 4.5.1)	$V_{DS(ON)}$		0.972 1.48 1.82	V dc V dc V dc
Forward voltage	4011	$V_{GS} = 0$ V dc, pulsed (see 4.5.1), $I_D = I_{D1}$	$V_{SD}$		1.5	V dc

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 3</u>						
High-temperature operation:		T <sub>C</sub> = T <sub>J</sub> = +125°C				
Gate current	3411	V <sub>GS</sub> = ± 30 V dc, bias condition C, V <sub>DS</sub> = 0 V	I <sub>GSS2</sub>		± 200	nA dc
Drain current	3413	V <sub>GS</sub> = 0 V dc, bias condition C, V <sub>DS</sub> = 80 percent of rated V <sub>DS</sub>	I <sub>DSS2</sub>		0.250	mA dc
Static drain to source on-state resistance	3421	V <sub>GS</sub> = 12 V dc, condition A, pulsed (see 4.5.1), I <sub>D</sub> = I <sub>D2</sub>	r <sub>DS(on)2</sub>			
2N7515					0.129	Ω
2N7516					0.324	Ω
2N7517					0.510	Ω
Gate to source voltage (threshold)	3403	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 1 mA dc	V <sub>GS(TH)2</sub>	1.0		V dc
Low-temperature operation:		T <sub>C</sub> = T <sub>J</sub> = -55°C				
Gate to source voltage (threshold)	3403	V <sub>DS</sub> = V <sub>GS</sub> , I <sub>D</sub> = 1 mA dc	V <sub>GS(TH)3</sub>		5.5	V dc
<u>Subgroup 4</u>						
Switching time test	3472	I <sub>D</sub> = I <sub>D1</sub> , V <sub>GS</sub> = 12 V dc, R <sub>G</sub> = 7.5Ω, V <sub>DD</sub> = 50 percent of rated V <sub>DS</sub>				
Turn-on delay time			t <sub>D(on)</sub>		20	ns
Rise time			t <sub>R</sub>			
2N7515					50	ns
2N7516					40	ns
2N7517					40	ns
Turn-off delay time			t <sub>D(off)</sub>		35	ns
Fall time			t <sub>f</sub>			
2N7515					30	ns
2N7516					15	ns
2N7517					15	ns

See footnotes at end of table.

TABLE I. Group A inspection - Continued.

Inspection <u>1/</u>	MIL-STD-750		Symbol	Limits		Unit
	Method	Conditions		Min	Max	
<u>Subgroup 5</u>						
Safe operating area test (high voltage)	3474	See figure 3; $t_p = 10$ ms, $V_{DS} = 80$ percent of max. rated $V_{DS}$ ( $V_{DS} \leq 200$ V)				
Electrical measurements		See table I, group A, subgroup 2 herein.				
<u>Subgroup 6</u>						
Not applicable						
<u>Subgroup 7</u>						
Gate charge	3471	Condition A or B				
On-state gate charge			$Q_{G(ON)}$			
2N7515					35	nC
2N7516					28	nC
2N7517					28	nC
Gate to source charge			$Q_{GS}$			
2N7515					13	nC
2N7516					12	nC
2N7517					12	nC
Gate to drain charge			$Q_{GD}$			
2N7515					12	nC
2N7516					10	nC
2N7517					10	nC
Reverse recovery time	3473	$di/dt = 100$ A/ $\mu$ s, $V_{DD} \leq 50$ V, $I_D = I_{D1}$	$t_{rr}$			
2N7515					160	ns
2N7516					210	ns
2N7517					360	ns

1/ For sampling plan, see MIL-PRF-19500.

2/ This test is required for the following end-point measurements only (not intended for screen 13): Group B, subgroups 3 and 4 (JANS); group B, subgroups 2 and 3 (JANTX, JANTXV); group C, subgroup 6; group E, subgroup 1.

TABLE II. Group D inspection.

Inspection 1/ 2/ 3/ 4/ 5/	MIL-STD-750		Symbol	Preirradiation limits		Postirradiation limits		Unit
	Method	Conditions		Min	Max	Min	Max	
<u>Subgroup 1</u>								
Not applicable								
<u>Subgroup 2</u>		$T_C = +25^\circ\text{C}$						
Steady-state total dose irradiation ( $V_{GS}$ bias)	1019	$V_{GS} = 12\text{V}$ $V_{DS} = 0$						
Steady-state total dose irradiation ( $V_{DS}$ bias)	1019	$V_{GS} = 0$ , $V_{DS} = 80$ percent of rated $V_{DS}$ (pre-irradiation)						
Breakdown voltage, drain to source	3407	$V_{GS} = 0$ , $I_D = 1$ mA bias cond. C	$V_{(BR)DSS}$					
2N7515				100		100		V dc
2N7516				200		200		V dc
2N7517				250		250		V dc
Gate to source voltage (threshold)	3403	$V_{DS} = V_{GS}$ , $I_D = 1$ mA dc	$V_{GS(TH)1}$	2.0	4.5	2.0	4.5	V dc
Gate current	3411	$V_{GS} = \pm 30$ V $V_{DS} = 0$ , bias cond. C	$I_{GSS1}$		$\pm 100$		$\pm 100$	nA dc
Drain current	3413	$V_{GS} = 0$ , bias cond. C $V_{DS} = 80$ percent of rated $V_{DS}$ (pre-irradiation)	$I_{DSS1}$		25		25	$\mu\text{A}$ dc
Static drain to source on-state resistance	3421	$V_{GS} = 12$ V, bias cond. A, pulsed (see 4.5.1) $I_D = I_{D2}$	$r_{DS(ON)1}$					
2N7515					0.080		0.080	$\Omega$
2N7516					0.180		0.180	$\Omega$
2N7517					0.255		0.255	$\Omega$
Static drain to source on-state voltage	3405	$V_{GS} = 12$ V, bias cond. A, pulsed (see 4.5.1) $I_D = I_{D1}$	$V_{DS(ON)}$					
2N7515					0.972		0.972	$\Omega$
2N7516					1.48		1.48	$\Omega$
2N7517					1.82		1.82	$\Omega$

1/ For sampling plan, see MIL-PRF-19500.

2/ Electrical specifications are for "D" and "R" rad levels.

3/ Group D qualification may be performed anytime prior to lot formation. Wafers qualified to these group D QCI requirements may be used for any other detail specification utilizing the same die design.

4/ Separate samples shall be pulled for each bias.

5/ At the manufacturer's option, group D samples need not be subjected to the screening tests, and may be assembled in its qualified package or in any qualified package that the manufacturer has data to correlate the performance to the designated package.

TABLE III. Group E inspection (all quality levels) for qualification only. 1/

Inspection	MIL-STD-750		Qualification and large lot quality conformance inspection
	Method	Conditions	
<u>Subgroup 1</u>			12 devices c = 0
Temperature cycling (air to air)	1051	Test condition F or G, 500 cycles	
Hermetic seal	1071		
Fine leak			
Gross leak			
Electrical measurements		See table I, group A, subgroup 2	
<u>Subgroup 2 2/</u>			12 devices c = 0
Steady-state reverse bias	1042	Condition B, 1,000 hours	
Electrical measurements		See table I, group A, subgroup 2	
Steady-state gate bias	1042	Condition A, 1,000 hours	
Electrical measurements		See table I, group A, subgroup 2	
<u>Subgroup 3</u>			
Not applicable			
<u>Subgroup 4</u>			22 devices c = 0
Thermal resistance	3161	$R_{\theta JC} = 5.0 \text{ }^{\circ}\text{C/W}$ maximum. See 4.5.2	
<u>Subgroup 5</u>			15 devices c = 0
Barometric pressure test (not required for $V_{BR(DSS)} \leq 200 \text{ V}$ ) 2N7517	1001	Test condition C  $V_{DS} = 250 \text{ V};$ $I_{(ISO)} < 0.25 \text{ mA}$	

See footnotes at end of table.

TABLE III. Group E inspection (all quality levels) for qualification only - Continued. 1/

Inspection	MIL-STD-750		Qualification and large lot quality conformance inspection
	Method	Conditions	
<u>Subgroup 6</u> Electrical measurements <u>3/</u> SEE <u>4/</u>		$I_{GSS1}$ and $I_{DSS1}$ in accordance with table I, group A, subgroup 2 Fluence = $3E5 \pm 20$ percent ions/cm <sup>2</sup> Flux = $5E3$ to $2E4$ ions/cm <sup>2</sup> /sec Beam energy = 260 to 360 MeV Temperature = $25^{\circ}C \pm 5^{\circ}C$ ; (see figure 4)	3 devices <u>5/</u> c = 0
2N7515		LET = 36 to 40 MeV-cm <sup>2</sup> /mg, ion range = 35 to 40 microns insitu bias conditions: $V_{DS} = 100V$ & $V_{GS} = -10V$  LET = 56 to 60 MeV-cm <sup>2</sup> /mg, ion range = 30 to 35 microns insitu bias conditions: $V_{DS} = 100V$ & $V_{GS} = -5V$ $V_{DS} = 50V$ & $V_{GS} = -8V$  LET = 80 to 84 MeV-cm <sup>2</sup> /mg, ion range = 25 to 30 microns insitu bias conditions: $V_{DS} = 80V$ & $V_{GS} = 0V$ $V_{DS} = 50V$ & $V_{GS} = -5V$	
2N7516		LET = 36 to 40 MeV-cm <sup>2</sup> /mg, ion range = 35 to 40 microns insitu bias conditions: $V_{DS} = 200V$ & $V_{GS} = -20V$  LET = 56 to 60 MeV-cm <sup>2</sup> /mg, ion range = 30 to 35 microns insitu bias conditions: $V_{DS} = 200V$ & $V_{GS} = -10V$  LET = 80 to 84 MeV-cm <sup>2</sup> /mg, ion range = 25 to 30 microns insitu bias conditions: $V_{DS} = 160V$ & $V_{GS} = -5V$ $V_{DS} = 120V$ & $V_{GS} = -10V$	
2N7517		LET = 36 to 40 MeV-cm <sup>2</sup> /mg, ion range = 35 to 40 microns insitu bias conditions: $V_{DS} = 250V$ & $V_{GS} = -20V$  LET = 56 to 60 MeV-cm <sup>2</sup> /mg, ion range = 30 to 35 microns insitu bias conditions: $V_{DS} = 250V$ & $V_{GS} = -10V$  LET = 80 to 84 MeV-cm <sup>2</sup> /mg, ion range = 25 to 30 microns insitu bias conditions: $V_{DS} = 200V$ & $V_{GS} = -5V$ $V_{DS} = 150V$ & $V_{GS} = -10V$	

See footnotes at end of table.

TABLE III. Group E inspection (all quality levels) for qualification only - Continued.

Inspection	MIL-STD-750		Qualification and large lot quality conformance inspection
	Method	Conditions	
<u>Subgroup 6</u> - Continued.  ESD  Electrical measurements <u>3/</u>	1020	$I_{GSS1}$ and $I_{DSS1}$ in accordance with table I, group A, subgroup 2	3 devices <u>5/</u> $c = 0$

- 1/ Group E qualification of SEE testing may be performed prior to lot formation. Wafers qualified to these group E QCI requirements may be used for any other performance specification utilizing the same die design.
- 2/ A separate sample for each test shall be pulled.
- 3/ As a minimum, gate to source leakages and drain to source leakage are to be examined to verify the electrical performance of the DUT prior to and after test. Other test conditions in accordance with table I, group A, subgroup 2, may be performed at the manufacturer's option.
- 4/ Devices passing a given combination of drain and gate voltage for an LET of 80 to 84 MeV-cm<sup>2</sup>/mg, qualify the same conditions for an LET of 56 to 60 MeV-cm<sup>2</sup>/mg, or an LET of 36 to 40 MeV-cm<sup>2</sup>/mg.
- 5/ This sampling plan applies to each bias condition specified.

TABLE IV. Groups B and C delta measurements.

Step	Inspection <u>1/</u> <u>2/</u>	MIL-STD-750		Symbol	Limits		Units
		Method	Conditions		Min	Max	
1.	Thermal response	3161	See 4.5.3	$\Delta V_{SD}$		230	mV

- 1/  $\Delta V_{SD}$  measurements shall be performed as part of group B, table VIa (JANS) of MIL-PRF-19500, subgroup 4.
- 2/  $\Delta V_{SD}$  measurements shall be performed as part of group C, table VII of MIL-PRF-19500, subgroup 4.

4.4.5 Design parameters. Not tested on a per lot basis. Design shall be such that the devices shall be capable of meeting the requirements on figure 4.

4.5 Methods of inspection. Methods of inspection shall be as specified in the appropriate tables and as follows.

4.5.1 Pulse measurements. Conditions for pulse measurement shall be as specified in section 4 of MIL-STD-750.

4.5.2 Thermal resistance. Thermal resistance measurements shall be performed in accordance with method 3161 of MIL-STD-750. The maximum limit of  $R_{\theta JC} = 5.0^{\circ}\text{C/W}$ . The following parameters shall apply:

- a. Measuring current ( $I_M$ )..... 10 mA.
- b. Drain heating current ( $I_H$ )..... 1 A.
- c. Heating time ( $t_H$ )..... Steady-state (see method 3161 of MIL-STD-750).
- d. Drain-source heating voltage ( $V_H$ )..... 25 V.
- e. Measurement time delay ( $t_{MD}$ )..... 30 to 60  $\mu\text{s}$ .
- f. Sample window time ( $t_{SW}$ )..... 10  $\mu\text{s}$  maximum.

4.5.3 Thermal response ( $V_{SD}$  measurement). The delta  $V_{SD}$  measurement shall be performed in accordance with method 3161 of MIL-STD-750. The delta  $V_{SD}$  conditions ( $I_H$  and  $V_H$ ) and maximum limit shall be derived by each vendor from the thermal response curves (see figure 2) and shall be specified in the certificate of conformance prior to qualification. The following parameter measurements shall apply:

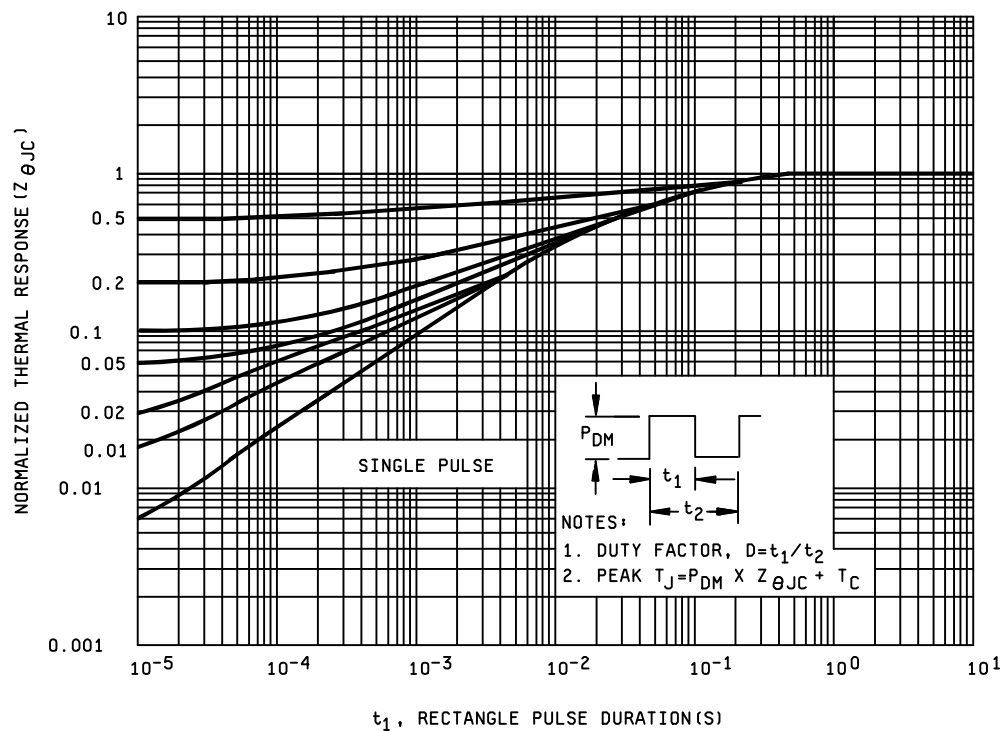
- a. Measuring current ( $I_M$ )..... 10 mA.
- b. Drain heating current ( $I_H$ )..... 1 A.
- c. Heating time ( $t_H$ )..... 10 ms.
- d. Drain-source heating voltage ( $V_H$ )..... 25 V.
- e. Measurement time delay ( $t_{MD}$ )..... 30 - 60  $\mu\text{s}$ .
- f. Sample window time ( $t_{SW}$ )..... 10  $\mu\text{s}$  maximum.

4.5.4 Single pulse avalanche energy ( $E_{AS}$ ).

- a.  $I_{AS}$  shall be as specified in paragraph 1.4.
- b.  $L = 0.1 \text{ mH}$ .
- c. Gate to source resistor ( $25 \leq R_{GS} \leq 200\Omega$ ).
- d.  $E_{AS} = 1/2 L I_{AS}^2$ .
- e.  $V_{DD} = 50 \text{ V to } 150 \text{ V dc}$ .
- f. Initial junction temperature =  $25^{\circ}\text{C}$ ,  $-5^{\circ}\text{C}$ ,  $+10^{\circ}\text{C}$ .

4.5.5 Gate stress test.

- a.  $V_{GS} = 45 \text{ V}$ .
- b.  $t = 250 \mu\text{s}$ , minimum.

FIGURE 2. Thermal impedance curves.

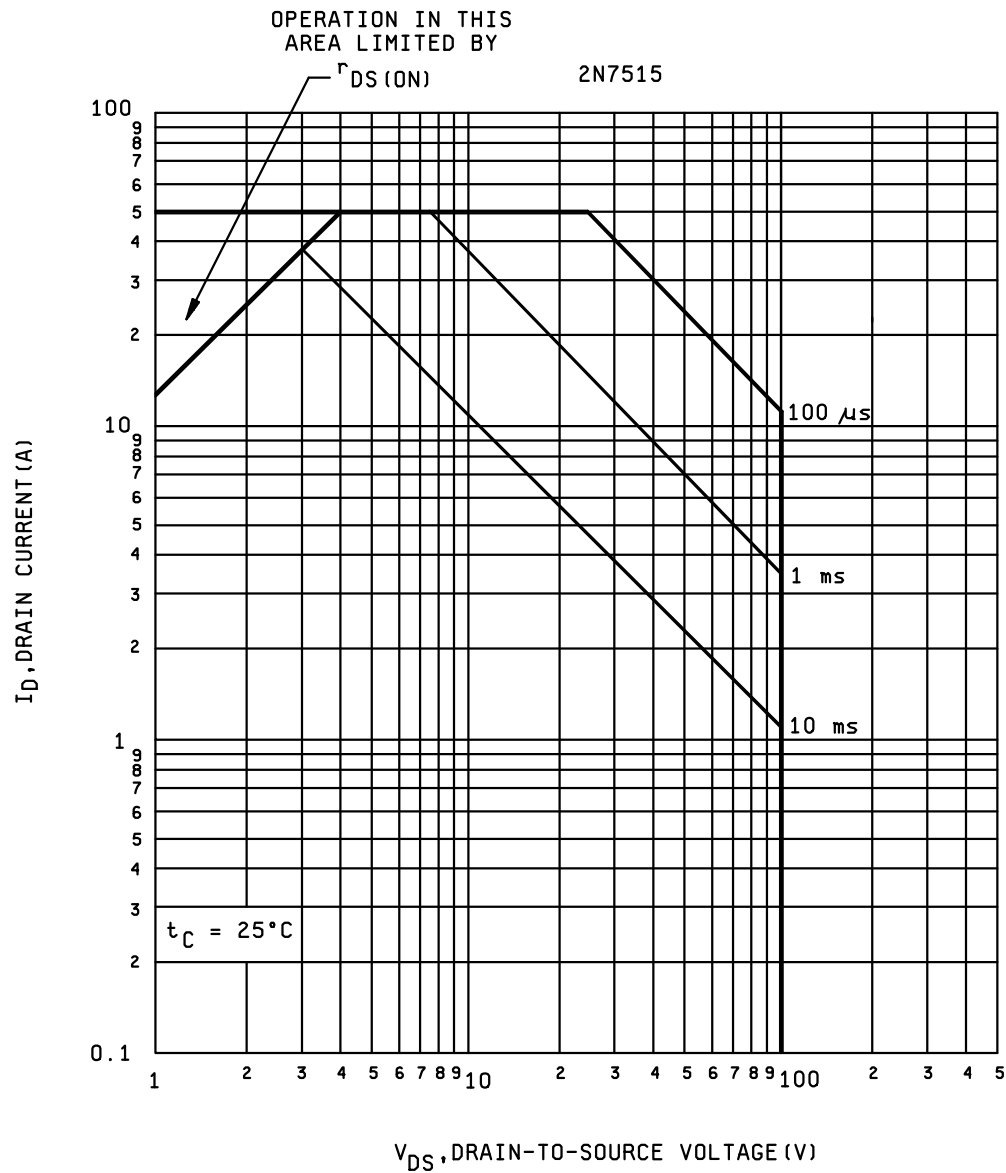
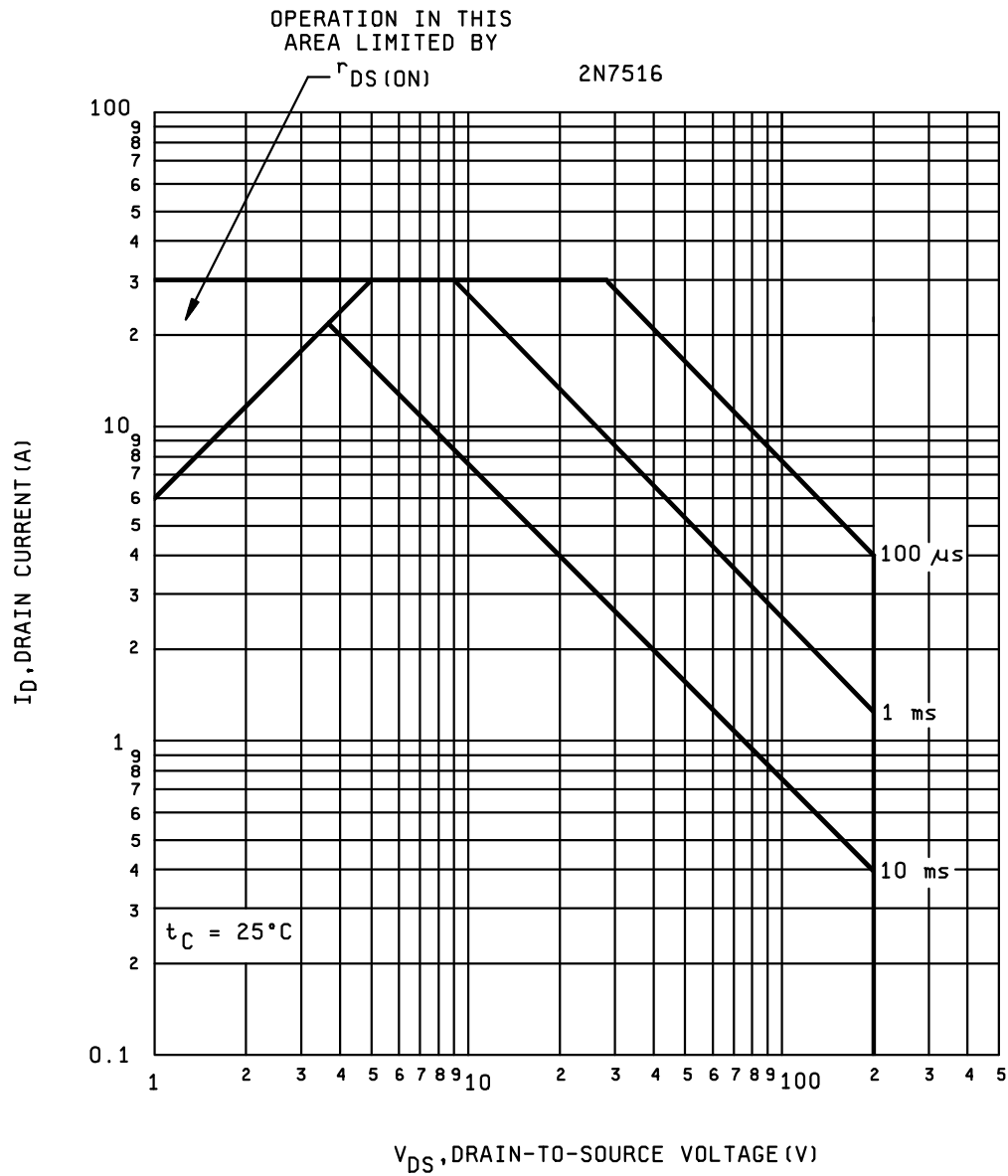
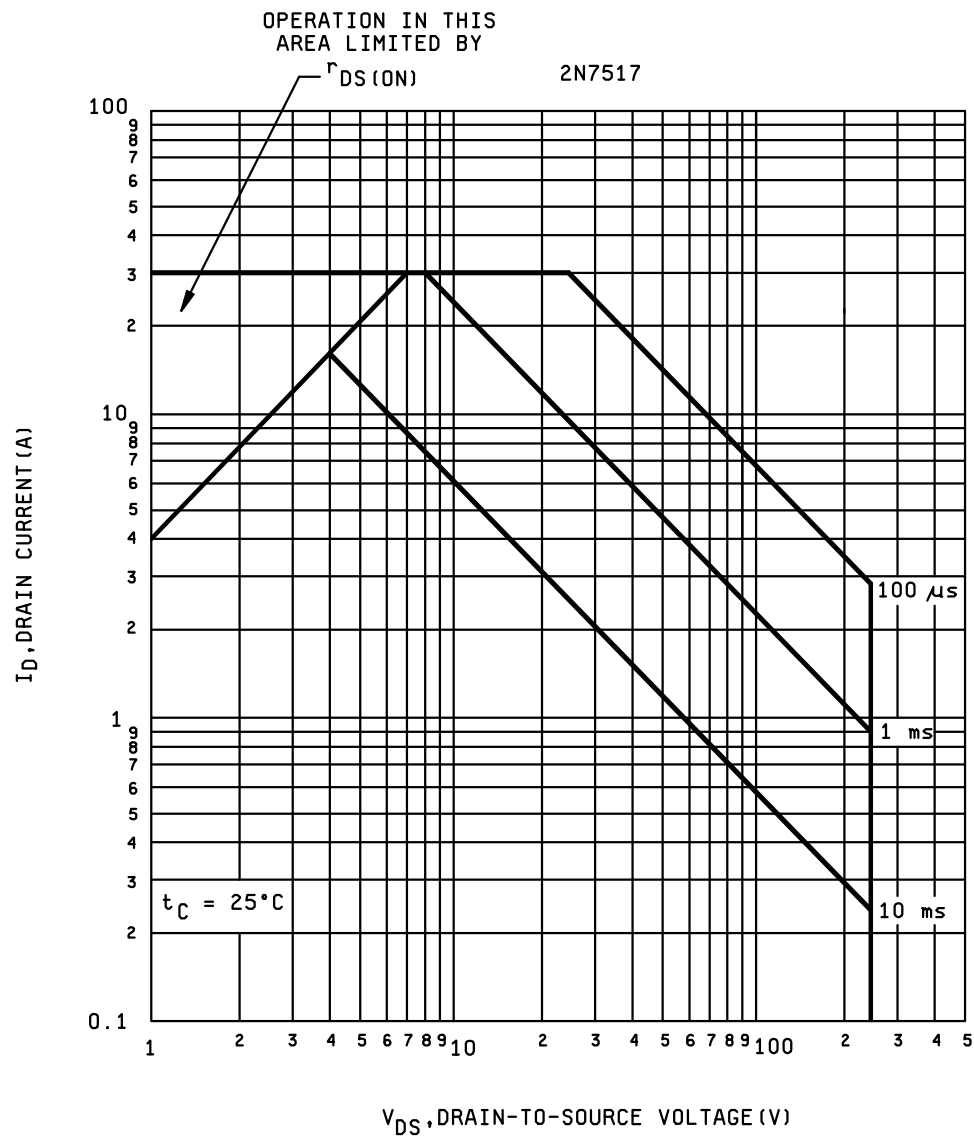
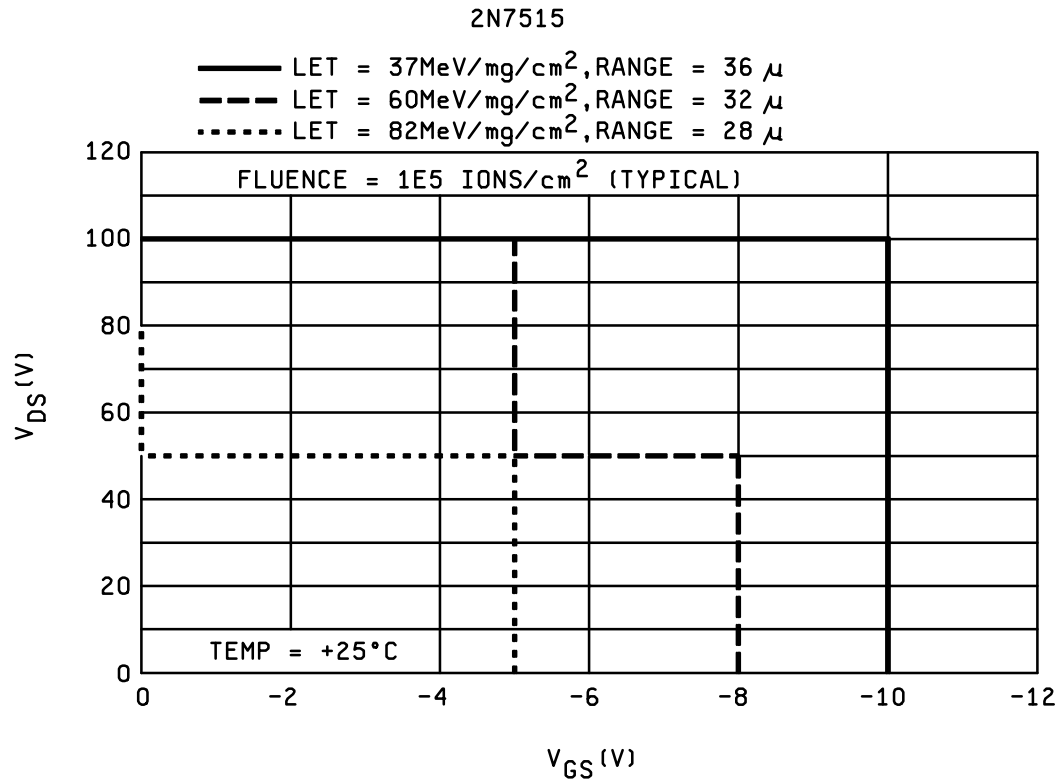


FIGURE 3. Safe operating area graphs.

FIGURE 3. Safe operating area graphs - Continued.

FIGURE 3. Safe operating area graphs - Continued.

FIGURE 4. SEE safe operating area graphs.

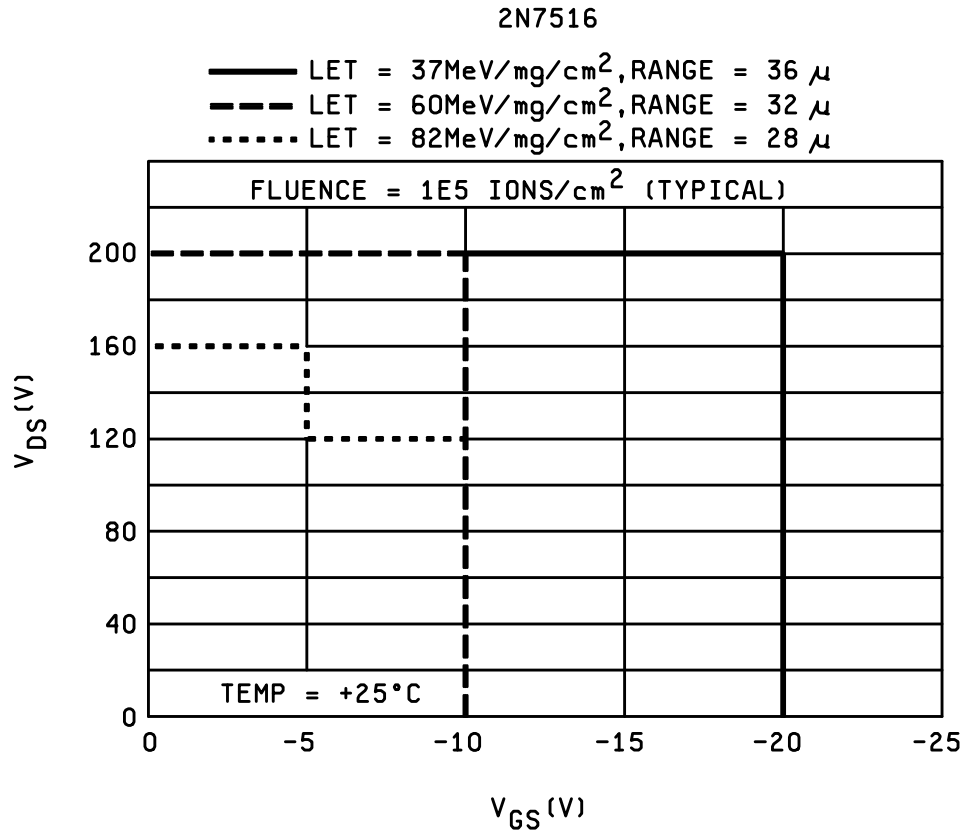
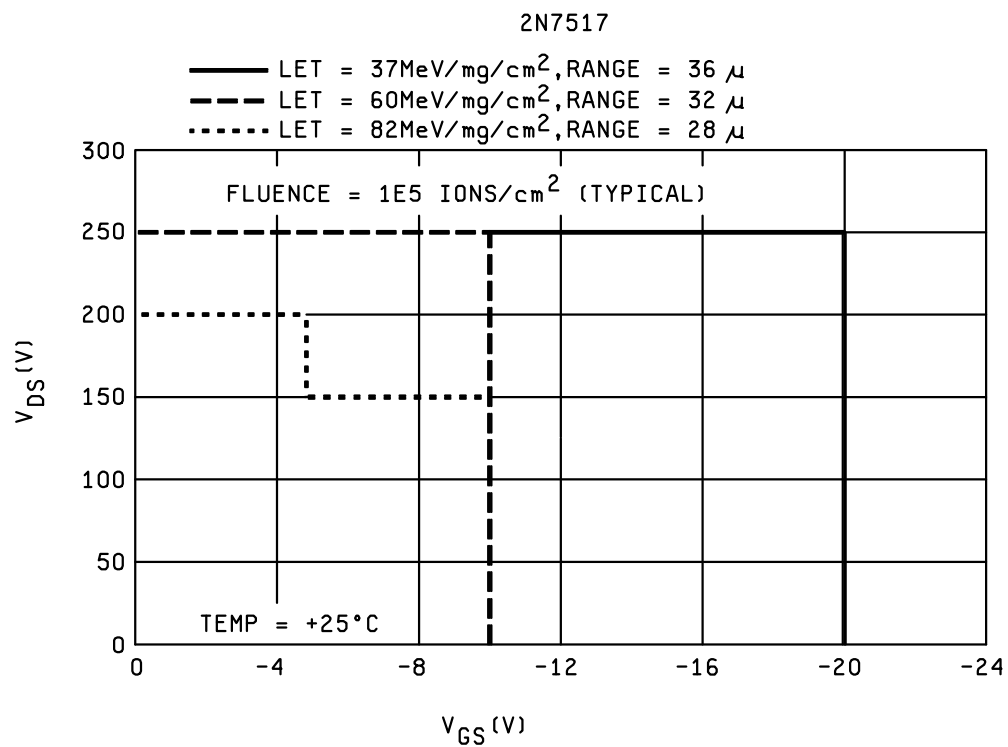


FIGURE 4. SEE safe operating area graphs - Continued.

FIGURE 4. SEE safe operating area graphs - Continued.

## 5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activity within the Military Department or Defense Agency, or within the Military Department's System Command. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

## 6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The notes specified in MIL-PRF-19500 are applicable to this specification.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Issue of DoDISS to be cited in the solicitation and, if required, the specific issue of individual documents referenced (see 2.2.1).
- c. Packaging requirements (see 5.1).
- d. Lead finish (see 3.4.1).
- e. Type designation and product assurance level.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Manufacturers' List (QML) whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Defense Supply Center, Columbus, ATTN: DSCC/VQE, P.O. Box 3990, Columbus, OH 43216-5000.

6.4 Cross-reference list. The following table shows the generic P/N and its associated military P/N (without JAN and RHA prefix).

Generic P/N	Military P/N
FSGL130	2N7515
FSGL230	2N7516
FSGL234	2N7517

Custodians:  
 Army - CR  
 Navy - EC  
 Air Force - 11  
 NASA - NA  
 DLA - CC

Preparing activity:  
 DLA - CC  
 (Project 5961-2415)

**STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL****INSTRUCTIONS**

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2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

**I RECOMMEND A CHANGE:**

1. DOCUMENT NUMBER  
MIL-PRF-19500/692

2. DOCUMENT DATE  
8 March 2001

3. **DOCUMENT TITLE** SEMICONDUCTOR DEVICE, FIELD EFFECT RADIATION HARDENED (TOTAL DOSE AND SINGLE EVENT EFFECTS) TRANSISTOR, N-CHANNEL SILICON TYPES 2N7515, 2N7516, AND 2N7517 JANTXVD, R AND JANSR, R

4. **NATURE OF CHANGE** (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)

5. **REASON FOR RECOMMENDATION**

**6. SUBMITTER**

a. NAME (Last, First, Middle initial)

b. ORGANIZATION

c. ADDRESS (Include Zip Code)

d. TELEPHONE (Include Area Code)  
COMMERCIAL  
DSN  
FAX  
EMAIL

7. DATE SUBMITTED

**8. PREPARING ACTIVITY**

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8725 John J. Kingman, Suite 2533, Fort Belvoir, VA 22060-6221  
Telephone (703) 767-6888 DSN 427-6888